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GROUNDWATER GEOLOGY IN WESTERN ILLINOIS, SOUTH PART

A Preliminary Geologic Report

Robert E. Bergstrom
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Service activities concerning groundwater are performed jointly by the Illinois State Geological Survey and the Illinois State Water Survey.

DIVISION OF THE
ILLINOIS STATE GEOLOGICAL SURVEY
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ABSTRACT

Geologic conditions controlling the availability of groundwater in the south part of western Illinois range from unfavorable to very favorable for domestic, municipal, and industrial supplies. This report presents a summary of groundwater principles, evaluates the geology in terms of the availability of groundwater for various purposes, and discusses methods of developing groundwater supplies. The maps and figures show: 1) areal and vertical distribution, type, and water-yielding character of upper bedrock formations, and 2) probability of occurrence and nature of sand and gravel aquifers. Summary logs of 16 key wells at selected locations give representative sequences of subsurface strata.

INTRODUCTION

The Mississippi and Illinois rivers and their tributaries are the most obvious water resources in western Illinois. These two river systems, through erosion, have also been mainly responsible for shaping the landscape.

Despite the vast amount of water available from the Mississippi and Illinois rivers, withdrawal of water from these sources for use by cities, farms, and industries in western Illinois has been relatively small. Most of the water supplies utilized directly or indirectly by man in the area comes from the great reservoir of water that is stored in the ground.

Water in the ground occurs in the soil zone within a few feet from the surface and in the deeper, permanently saturated groundwater reservoir. Soil water is utilized by crops and other vegetation, which are the greatest single users of water. Groundwater, which occurs at some distance below the soil moisture zone in most of western Illinois, is obtained by wells and is the major source of water supply for farms, cities, and industries in the region. The demand for groundwater is great because surface-water supplies are not always present where needed, and even where present they commonly require considerable capital outlay for collection and treatment.

The availability, quantity, and quality of groundwater depend upon the nature and arrangement of the earth materials beneath the surface, that is, upon geologic conditions. Any groundwater supply, whether for small domestic needs or for the large requirements of a city or industry, can be obtained only where there are rocks that can transmit water. Rocks which transmit water are said to be permeable and are technically called aquifers. Because geologic conditions change from place to place, in some areas groundwater is readily available for all purposes, whereas in others it is difficult to obtain even small supplies.

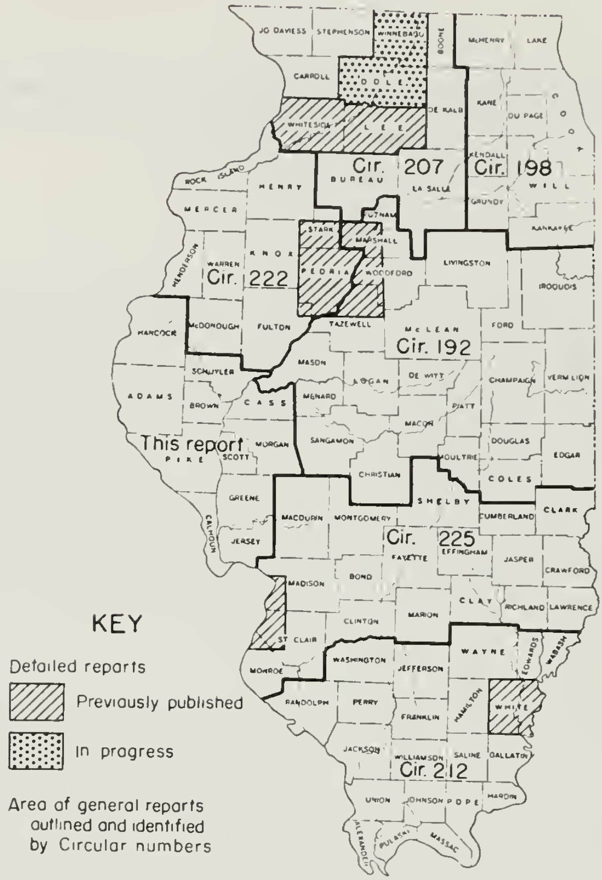

Fig. 1. - Index map showing areas for which reports on groundwater geology in Illinois have been published since 1950 or are in progress.

Knowledge of the distribution and character of aquifers in any area is necessary to develop groundwater supplies properly. This report provides information on the availability of groundwater in the south part of western Illinois and discusses principles of groundwater occurrence and development. It is part of a program aimed at improving water supplies on Illinois farms, in which the Illinois State Geological Survey is cooperating with the Extension Service of the Agricultural Engineering Department, College of Agriculture, University of Illinois.

The report is the seventh in a series.* It describes the south half of Agricultural Extension District 2 and west part of District 4 and includes the following eleven counties: Adams, Brown, Calhoun, Cass, Greene, Hancock, Jersey, Morgan, Pike, Schuyler, and Scott (figs. 1 and 2).

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* Previous reports in the series, listed in "Suggested Reading" on page 28 and shown by area in figure 1, are available upon request from the Survey in Urbana.

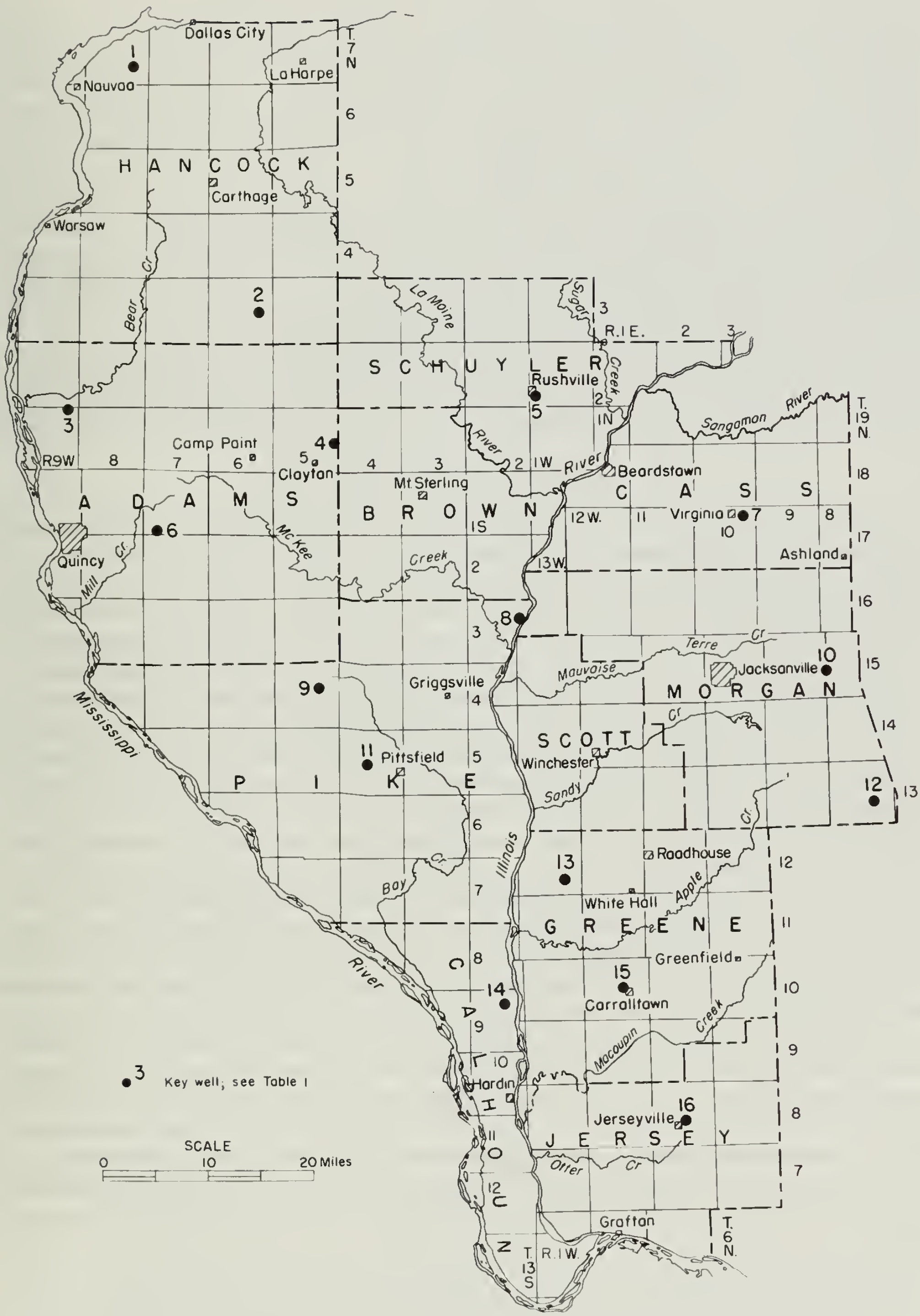

Fig. 2. - Western Illinois, south part, showing location of key wells.

The region has an area of about 5,600 square miles and a population of slightly more than a quarter of a million. Less than three-fourths of the land is tillable because it has been extensively dissected by the Mississippi and Illinois rivers and their tributaries. About three-fourths of the commercial farms are livestock and grain farms. In Calhoun County and parts of Jersey, Pike, and Adams counties, where the land is too rough for the cultivation of annual crops, soil and climatic conditions favor the production of fruit, especially apples. Quincy and Jacksonville are the two largest cities in the region.

Drilling contractors in western Illinois have assisted in the preparation of this report by providing large numbers of logs of water wells for the files of the Geological Survey and by supplying information on specific problems of occurrence of water-yielding materials and drilling conditions.

We are also pleased to acknowledge the assistance given by members of the Groundwater Division and other divisions of the State Geological Survey. Most of the data on water quality and well yields contained in this report have been taken from records or published reports of the Illinois State Water Survey.

OCCURRENCE OF GROUNDWATER

Because groundwater occurs beneath the surface of the earth and is hidden from view it is often regarded as somewhat mysterious. Throughout human history many fanciful explanations have been presented to describe its source, movement, and occurrence. Scientific study has shown, however, that groundwater obeys certain physical laws or principles which are relatively simple and easily understood, although complex in detail. Our present understanding of the source, movement, and occurrence of groundwater and the relationship of groundwater to other water sources are shown diagrammatically in figure 3.

The source of groundwater is rain, snow, or ice that falls on the earth from the atmosphere and seeps into the ground. The tremendous quantity of water that falls on the land surface by precipitation is seldom realized, but it is far more than adequate to supply our vast groundwater reservoir. According to records of the State Water Survey, during a year of average precipitation in the vicinity of Quincy nearly a million gallons of water falls on each acre of land.

Most of the precipitation runs off in streams or is returned to the atmosphere by evaporation and transpiration. The remaining moisture filters slowly down into the ground until it reaches a level below which all available openings are filled with water. The top of this zone of saturation is called the water-table. When a well is drilled or dug, it is dry until it penetrates the zone of saturation; the position of the water-table is then shown by the level at which water stands in the well. The water-table is not a level surface but conforms more or less to the principal features of the land surface. Where the water-table intersects the land surface, groundwater is discharged as seeps and springs that feed perennial streams, lakes, and swamps. The water-table does not remain stationary but fluctuates in response to the loss or gain of groundwater.

Groundwater moves under the influence of gravity or in response to other natural pressure differentials toward points of lowest pressure, which are nearly always places of discharge, such as springs, marshes, or pumped wells.

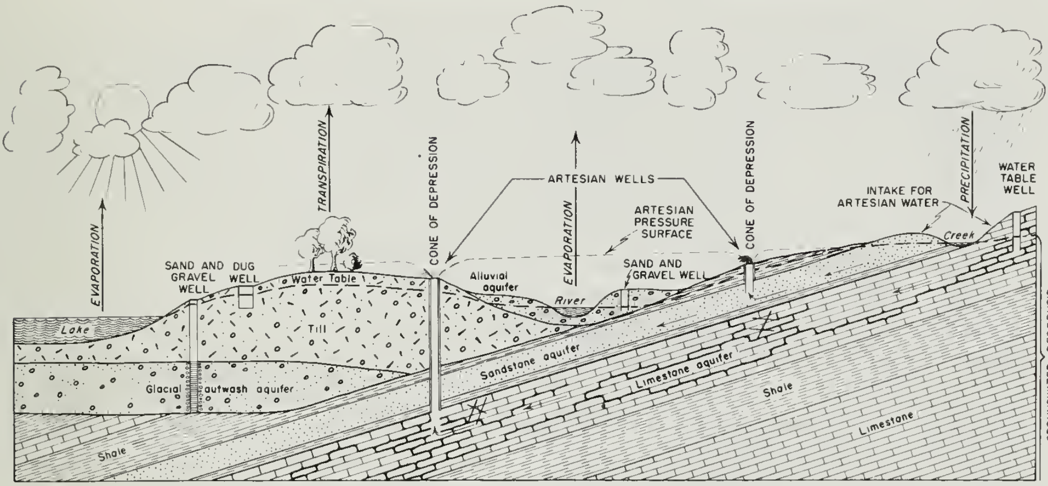

Fig. 3. - Source, movement, and occurrence of groundwater.

This movement is slow because there is friction between the water and the walls of the pores or crevices in the rock.

In places where the top of the zone of saturation is not confined and can rise or fall freely as water is added or removed, groundwater is said to be under water-table conditions. Under these conditions and under the influence of gravity groundwater moves freely, hindered only by friction, in the direction of the slope of the water table.

Commonly the permeable aquifer is overlain by a less permeable material that restricts the upward movement of groundwater. Under these conditions, the water in the confined aquifer is subject to pressure that causes the water in a well to rise above the top of the aquifer. In this case groundwater is said to be confined, or under artesian conditions. Where sufficient pressures are encountered in an artesian well, the water may rise above the land surface and make a flowing well.

To supply a pumped or flowing well, groundwater must move through the earth materials toward the well. Under water-table conditions, pumping lowers the water table in the vicinity of the well and induces the flow of groundwater toward the well from adjacent areas. Under artesian conditions, pumping causes a reduction of hydrostatic pressure in the vicinity of the well, which induces the flow of groundwater toward the well. The depression in the water table or in the artesian pressure surface, which results from pumping, is in the form of an inverted cone with the well at the center. It is called the cone of depression (fig. 3).

Groundwater is not everywhere available in sufficient quantities to satisfy human requirements. The availability of groundwater in humid regions such as western Illinois is basically dependent upon the presence of aquifers. Aquifers such as sand and gravel store considerable water and transmit it readily. Other earth materials, such as clay and shale, may contain even more water per cubic foot than sand and gravel, yet retard movement of groundwater to such a degree that they will not yield appreciable quantities of water to a well. The value of an aquifer depends upon the type, size, number, and degree of interconnection of the openings that may store and conduct groundwater.

System	Formation: North part W Illinois	Formation: This area	Graphic Log	Rock Type and Thickness	Water-Yielding Characteristics, Drilling and Well Construction Details.
Pleistocene Series				Unconsolidated glacial deposits, loess (wind-blown silt) and alluvium. 0-250'	Water yielding character variable Large yields from thick sand and gravel deposits in bedrock valleys Wells usually require screens and careful developement
Pennsylvanian				Mainly shale, with sandstone, limestone and coal 0-430'	Generally unfavorable as water source Locally, domestic and farm supplies obtained from thin sandstone, limestone, and coal beds. Caving shales require casing
Mississippian	Ste Genevieve - St Louis - Salem			Sandy oolitic limestone Dense limestone Fossiliferous oolitic limestone 0-325'	Thin, usually not water-yielding west of Illinois River Thicker, occasionally water-yielding east of river and in southern Calhoun County
	Warsaw			Shale with some limestone 0-125'	Not water-yielding at most places Casing required
	Keokuk-Burlington			Cherty limestone, some shale near base 0-275'	Generally creviced and water-yielding Main aquifer for domestic supplies Wells penetrate limestone from 30 to 150 feet Tight at some locations
Mississippian / Devonian	Kinderhook			Shale and limestone Some sandstone and siltstone 0-325'	Not water-yielding at most locations. Locally, limestones yield small quantities of water Casing required.
Devonian				Limestone, some sandstone	Not important groundwater source, except locally for small supplies in Calhoun County Gas, oil, or salt water found at some locations.
Silurian				Cherty limestone, dolomite 0-225'	
Ordovician	Maquoketa			Greenish shale, some dolomite and siltstone 0-250'	Not water-yielding at most places Casing required.
	Galena-Decorah-Platteville (Trenton)	Kimmswick-Decorah-Plattin-Joachim		Limestone, shaly zone in upper part Dolomite in lower part 0-340'	Commonly tight. Not important as aquifer Yields some domestic supplies in Calhoun County.
	Glenwood - St Peter			Clean, poorly cemented sandstone 0-320'	Permeable and water-yielding Water rather strongly mineralized in most of area Favorable aquifer in part of Calhoun County.
	Shakopee	Cotter		Dolomite, cherty above, sandy below 330-400'	Rarely penetrated by water wells in most of area because of great depth and probability of obtaining highly mineralized water
		Jefferson City			
	New Richmond	Roubidoux		Sandstone, some dolomite 35-150'	
	Oneota	Gasconade		Cherty dolomite 240'-340'	
		Van Buren			
	Gunter			Sandstone and dolomite 10-70'	
Cambrian	Trempealeau	Eminence		Dolomite 90-250'	
		Potosi		Dolomite 0-250'	
	Franconia	Derby-Doerun		Dolomite and shale 140-360'	
		Davis			
	Ironton-Galesville				
	Eau Claire	Bonne Terre		Limestone and dolomite, sandy in upper and lower parts 70-430'	
	Mt Simon	Lamotte		Sandstone 0-440'	
Pre-Cambrian				Granite and other crystaline rocks extending to great depth	

Fig. 4. - Generalized column of rock formations in western Illinois, south part.

In western Illinois, the important aquifers are sand and gravel, limestone and dolomite (a limestone-like rock rich in magnesium), and sandstone. Many sand and gravel deposits are water-yielding because the openings between the individual grains are large enough to allow relatively rapid movement of water. Good water-yielding sand and gravel deposits are composed of grains that are nearly all the same size and coarser than granulated sugar. If large amounts of clay and silt are present in the sand and gravel deposits, the openings between the larger grains are clogged and the movement of water is retarded. Sand and gravel deposits in the area of this report range in thickness from a few inches to nearly a hundred feet. Deposits a few feet or more thick are often suitable aquifers for drilled wells. Thinner deposits of sand and gravel in otherwise tight earth materials are suitable aquifers only for dug or augered wells of large diameter.

Water-yielding sandstone formations also transmit groundwater through the openings between sand grains. As in sand and gravel deposits, any material that clogs the openings between the sand grains reduces the water-transmitting capacity of the formation. Sandstone formations contain variable amounts of cement, and some sandstones are so thoroughly cemented that whatever water is present moves primarily through joints and fractures. Relatively few wells have been completed in sandstone in the area of this report. Locally, however, the St. Peter sandstone (Ordovician) and thin fine-grained Pennsylvanian sandstones are groundwater sources (figs. 4, 5, and 6).

Tight, compact rocks like limestone and dolomite yield groundwater to wells from interconnected cracks and solution channels. Because these water-filled openings are irregular in size and distribution, the yields of closely spaced limestone or dolomite wells may be quite different. The Keokuk-Burlington limestone (Mississippian) is fairly well creviced at most places in the region and is usually a dependable source of groundwater for farm supplies (figs. 4 and 6).

GEOLOGY

The branching and rebranching tributaries that cut into the uplands along the main trunk valleys of the Mississippi and Illinois rivers have shaped much of western Illinois into a landscape of bold bluffs, deep hollows, and narrow upland prairies. The most rugged part of the region is Calhoun County, which stands as a high rocky divide between the Mississippi and Illinois rivers. East of Illinois River, in eastern Jersey, Morgan, and Cass counties, the land surface is less broken and merges into the flat prairies of central Illinois.

Although the region has been sculptured primarily by running water, important developments in the landscape took place during the geologically recent Ice Age (Pleistocene Epoch) when great continental glaciers advanced across Illinois. The glaciers, advancing outward from centers of snow accumulation in Canada, transported a great quantity of rock debris, and in melting deposited it as a surface mantle which smoothed pre-existing irregularities and produced broad, flat upland plains in much of western and central Illinois. The only part of western Illinois which escaped glaciation was an area including most of Calhoun County and a small part of Jersey County, although all the surrounding lands at one time or another were invaded by ice (see glacial boundary in fig. 7).

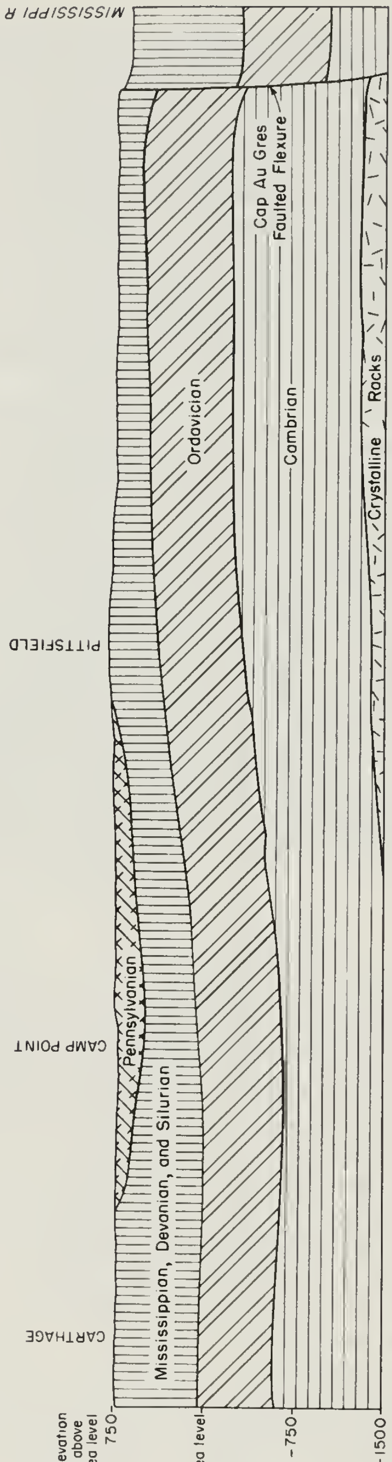

Fig. 5. - Cross section of bedrock formations from Carthage south through Calhoun County.

Of the several glacial advances during the Ice Age only the earlier ones (Illinoian and older) reached the region of the lower Illinois Valley. Subsequent glaciations fell short of the region, although great volumes of meltwater from the later ice sheets flowed down the Mississippi and Illinois river valleys. The deposits left by the Illinoian and older glaciers have been extensively eroded in western Illinois since their deposition. This is in contrast to northeastern Illinois where the later glacial deposits (Wisconsin) have been subject to only brief erosion, so that the rolling, hummocky topography is essentially as it was when the ice melted.

The glacial deposits (drift) which have escaped erosion in the lower Illinois Valley area are complex. Much of the upland is blanketed by unsorted rock debris, called till, which was deposited by the ice during melting. In the valleys and in some places on the uplands are beds of sand and gravel which meltwaters carried away from the ice front and deposited. These deposits are called outwash. On the uplands, and especially near the river bluffs, are deposits of silt and fine sand that were blown from barren river flats kept free of vegetation by frequent glacial flooding. The windblown silt deposits (loess) occur throughout the area, including Calhoun County which was largely unglaciated. Loess, till, outwash, and the sediments of modern streams form a mantle over the bedrock in much of western Illinois.

The nature of the bedrock and its relationship to the overlying mantle are well shown in the steep bluffs that border Mississippi and Illinois rivers. Similar information is obtained from records and samples of wells and borings in areas where the bedrock is more or less completely buried.

The bedrock consists of layers of shale, coal, limestone, dolomite, and sandstone, arranged one above the other like the pages of a book (figs. 4 and 5). These rocks were originally deposited as loose sediments in shallow continental seas but were later buried and hardened. They are several hundred million years old, whereas the glacial deposits which overlie them are probably less than a million years old. During the long interval of time between the deposition of the bedrock formations and the glacial deposits the area stood, as now, above sea level and was subject to erosion. Tilting and warping of the bedrock layers from their original horizontal position occurred at that time.

In southern Calhoun and Jersey counties the bedrock formations have been sharply bent and in places broken along a line that extends from just north of Brussels through Pere Marquette State Park (figs. 5 and 6). This structure is called the Cap au Gres faulted flexure. As shown in figure 5, the rocks north of the flexure lie about a thousand feet above the corresponding rocks to the south. Along the flexure the rocks dip steeply southward and are broken by fractures called faults.

The bedrock layers dip eastward or northeastward about 15 to 50 feet per mile in the area of this report, although there are numerous local upfolds (anticlines) and downfolds (synclines) that modify or reverse the regional dip. Drilling for oil and gas has been concentrated mainly on anticline or dome structures in accordance with established exploration practice in many oil producing areas. Gas was formerly produced from Silurian rocks (fig. 4) along an anticlinal structure west of Pittsfield (Pittsfield-Hadley anticline) and has

Fig. 6. - Areal distribution, type, and water-yielding character of upper bedrock formations (modified from Geologic Map of Illinois, 1945).

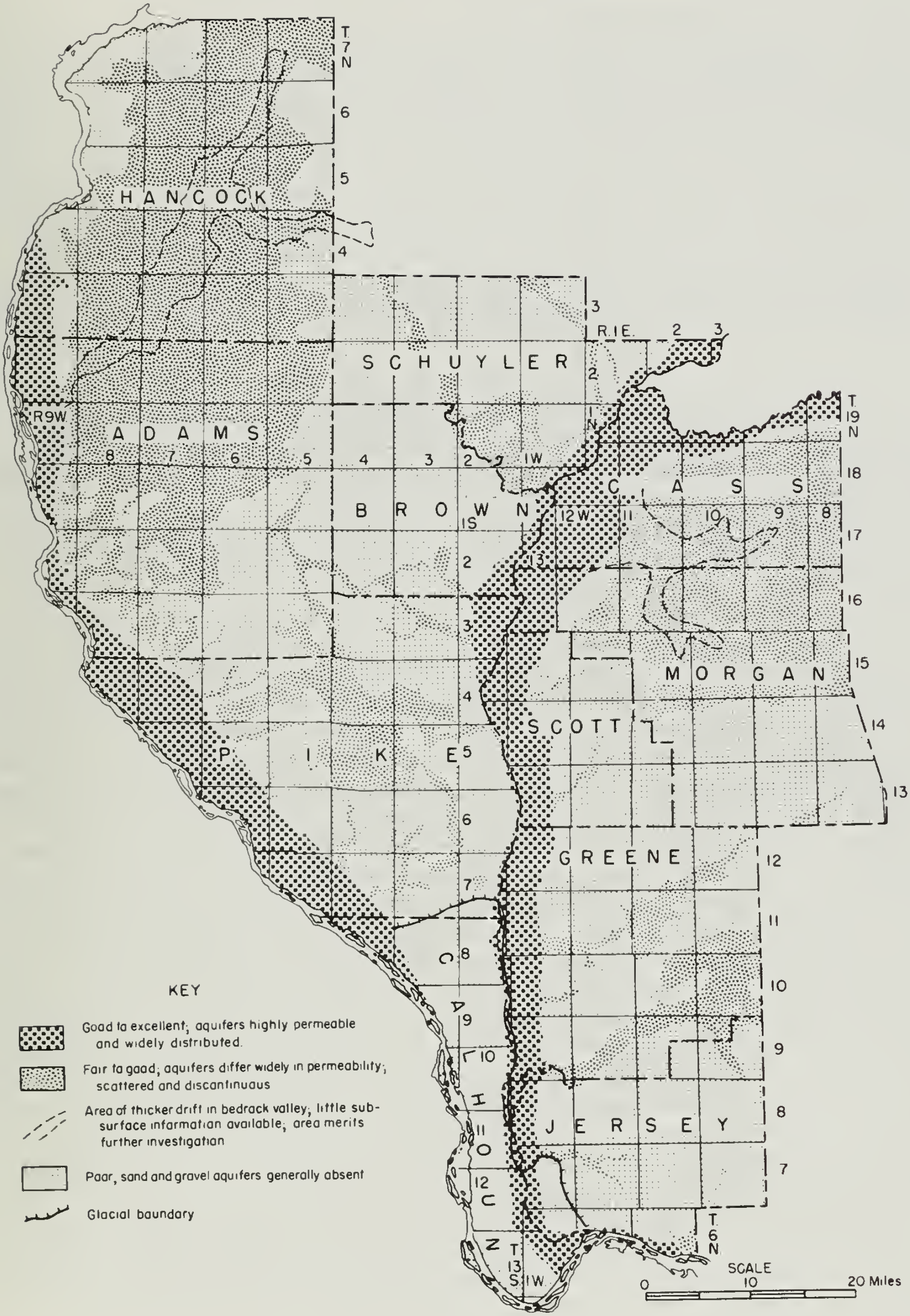

Fig. 7. - Probability of occurrence and nature of sand and gravel aquifers.

recently been discovered under similar conditions in a small area in Pike County northwest of Pittsfield, between Baylis and Fish Hook near the southeast corner of Adams County. Oil has been produced for many years from Devonian rocks in the Colmar-Plymouth field, a low structural dome in southwestern McDonough, northwestern Schuyler, and southeastern Hancock counties.

Beneath the layered rocks, shown in figs. 4 and 5, are ancient crystalline rocks which form the "basement." The basement rocks are mainly granitic in composition, as is indicated by a few very deep borings in Illinois. In Pike County two deep oil tests (wells 9 and 11, fig. 2 and table 1) reached granitic rocks at depths of 3204 and 2221 feet respectively.

DISTRIBUTION OF AQUIFERS

Sand and gravel beds occur in the unconsolidated material that glaciers and running water have deposited on the bedrock surface (fig. 3). Dolomite, limestone, and sandstone aquifers occur in the bedrock. The vertical sequence of earth materials in the area is given in figure 4.

Figure 6 shows the areal distribution and water-yielding properties of the upper bedrock formations that are penetrated at land surface or beneath the glacial material. Table 1 gives summary logs of 16 key wells to show the sequence of bedrock formations encountered at selected locations.

In many places, particularly along the courses of streams or of glacial or preglacial drainage ways, sand and gravel deposits merit careful consideration as a source of groundwater. Figure 7 shows the probability of occurrence of sand and gravel aquifers. The areas shown as "good to excellent" are underlain by thick unconsolidated deposits containing sand and gravel, which occur mainly in major bedrock valleys. Groundwater for domestic and farm supplies may be obtained in this area from small-diameter drilled wells in sand and gravel. Possibilities for municipal or industrial wells are good to excellent, although test drilling is necessary to locate the best formation and site for the construction of high-capacity wells and to obtain information on water quality.

The areas shown as "fair to good" in figure 7 have moderately thick glacial deposits that border the deep channels of bedrock valleys or fill tributary valleys and include some sand and gravel. Groundwater for domestic and farm supplies may be obtained locally in these areas from drilled wells in sand and gravel, but at some locations these deposits are absent and wells are usually drilled into the bedrock. The probabilities for obtaining supplies of water for industrial and municipal purposes are poor to fair. Extensive test-drilling is likely to be necessary to locate water-yielding sand and gravel deposits suitable for such purposes. Areas outlined by dashes appear to be more promising but have not been sufficiently tested to be proved.

The areas shown as "poor" are primarily bedrock upland with glacial deposits thin, absent, or composed mainly of tight till. Sand or gravel capable of supplying groundwater is rare, and most wells obtain water from the bedrock.

DEVELOPMENT OF GROUNDWATER SUPPLIES

Geologic Conditions that Affect Groundwater Development

The amount and quality of groundwater available in an area are controlled by geologic factors that must be considered in developing groundwater supplies. These factors, which are discussed relative to individual occurrences in other sections of this report, are summarized as follows:

1) Distribution of aquifers, including presence or absence, depth and thickness, and areal extent.
2) Nature of aquifers, including type of material, kind of openings (pores or crevices), and presence of substances which affect water quality.
3) Geologic structure, including regional and local dip of beds, faults, and jointing.
4) Distribution and nature of non-water-yielding materials.

The mere presence of an aquifer is not in itself enough to assure that a satisfactory groundwater supply can be obtained in a given area. Care must be taken to select the aquifer most suitable for the water supply required, to adapt the type and manner of construction of the well to the geologic conditions, and to place the well where it will best maintain the required standards of quality and quantity of water.

Unconsolidated Deposits

Where extensive water-yielding sand and gravel deposits are present, consideration should usually be given to developing wells in them rather than in the underlying bedrock. Sand and gravel wells may have one or more of the following advantages over bedrock wells, particularly over deep bedrock wells: shallower water levels, colder water, greater water yields to specific wells, and, locally, water of better mineral quality. A disadvantage of sand and gravel wells is the special construction needed to take full advantage of the water-yielding capacity of the aquifer.

Illinois State Water Survey records show that considerable iron may be found in sand and gravel wells locally along the Mississippi and Illinois rivers. The areas of iron concentration are not clearly defined because data are incomplete; however, the possibility of encountering water with objectionably high iron content must be considered in planning groundwater developments in the valley areas. Water-well drillers who operate in these areas report that commonly water from the deeper deposits is "rusty" and therefore most farm wells in the bottomlands are finished at depths as shallow as possible.

High-capacity sand and gravel wells require the use of screens, which allows the flow of sand-free water into the well bore. It is important, in the development of sand and gravel wells, that the size of the screen openings or slots be chosen on the basis of the size of the material to be screened. Therefore it is necessary that samples of the aquifer be obtained and analyzed for particle size to determine the correct size of the screen opening.

Development necessarily follows construction of a sand and gravel well. In proper development, the finer grained materials in the immediate vicinity of the well bore are drawn through the screen and removed, which leaves a natural graded filter that prevents pumping of sand and silt. Better results and yields may be obtained from some sand and gravel deposits by placing an "envelope" or "pack" of selected gravel or coarse sand between the deposit and the screen. The grain size of the particles in the gravel pack must have the proper relationship to the grain size and sorting of the formation and to the screen slot size to achieve the best results (see Smith, H. F., Gravel packing water wells, Illinois State Water Survey Circ. 44). The use of open pipe, or slotted pipe, or pipe filled with gravel should be avoided except in very coarse deposits where the well will yield far more water than is pumped.

The physical characteristics of sand and gravel deposits are generally more variable than those of bedrock formations. For this reason, groundwater development from sand and gravel sources usually requires test drilling prior to well design and construction. In areas where the presence of suitable aquifers is uncertain, a test-drilling program is necessary to determine whether suitable deposits are present and, if present, the best location for the well. Data on the suitability of water quality at specific sites should also be obtained in the exploration program.

Test-drilling is generally done by drilling small-diameter holes with cable tool (percussion) or with rotary drilling equipment. The test-driller's report is an important part of the groundwater development program and should include the following information when obtainable: 1) driller's log of formations penetrated, 2) static water level and changes in water levels during drilling, 3) drilling time of the individual formations, 4) weight and viscosity of drilling mud, and 5) loss of mud or fluid during drilling. Samples of drill cuttings should be saved at a five-foot interval and also where there are changes in the type of material.

Conditions favorable for drilled wells in sand and gravel in western Illinois are found mainly in and along the Illinois, Mississippi, La Moine, Mill, Macoupin and Apple Valleys (fig. 2).

Driving a sand point is the quickest and most economical method of well construction but is practical only where small supplies of groundwater are needed and where such supplies are available from sand and gravel at shallow depths. Conditions are suitable for driven wells in the Illinois, Mississippi, and La Moine valley-bottoms and locally in minor tributaries.

Large-diameter (2 to 5 feet) dug wells are most suitable in areas where the unconsolidated materials are fine-grained and cannot yield water readily to a drilled or driven well; therefore they are used widely throughout much of the area in which glacial material is thin and tight and is underlain by Pennsylvanian rocks of low permeability. Large-diameter wells are excavated by hand or by power auger, shovel, or bucket and can be excavated to depths up to about 100 feet. In areas where conditions are favorable for drilled or driven wells, the use of large-diameter dug wells is not recommended because of pollution and maintenance problems. The chief advantage of a large-diameter well is that it can store relatively large quantities of water. Short intermittent pumping of a large-diameter well does not require immediate release of water from the surrounding materials, and the well can refill slowly between times of pumping. Special sanitary precautions should be taken with large-diameter wells. (See Illinois State Department of Public Health Circ. 14A.)

Bedrock Formations

Wells constructed in bedrock aquifers are generally less difficult to design because the well bore is usually left uncased and because the aquifers are more consistent over wider areas. Test drilling in bedrock aquifers is seldom done, particularly where records of prior drilling in the area are available.

In western Illinois the most important geologic factors affecting well construction in bedrock aquifers are: 1) type, thickness, depth, and permeability of aquifers; 2) ability of formations to sustain open hole without casing or lining; 3) tendency of formations to yield silt or sand during pumping; and 4) differences in the quality of water contained in different formations.

Creviced dolomite and limestone do not normally require casing or lining. However, where groundwater supplies are obtained from near-surface dolomite or limestone formations with less than about 35 feet of overburden, there is danger of bacterial pollution. The open crevices provide little filtering or other purifying action, and polluted water may travel long distances through these openings.

Normal drilling procedure in the development of bedrock aquifers is to install surface casing to firm bedrock and to continue into the bedrock with an open hole. Where a bedrock formation is too weak to sustain an open hole, it may be necessary to continue the surface casing through the weak formation into a more competent underlying formation or to set liners. The most important caving zones requiring casing are in the Pennsylvanian, Warsaw, and Kinderhook shales (fig. 4).

Conditions are generally favorable in western Illinois for drilled wells in bedrock. The main aquifers exploited for farm supplies are the Keokuk-Burlington limestone and in Calhoun County the Devonian-Silurian, Kimmswick-Joachim, and St. Peter formations (figs. 4 and 6, and table 1).

Large Groundwater Supplies

Development of groundwater supplies for municipal, industrial, and irrigation purposes requires technical advice and careful planning based on all available geologic and hydrologic data. The type, extent, thickness, depth, distribution, and water-yielding characteristics of aquifers in the area should be determined so that the available quantity of water may be estimated and plans made for proper well construction. Hydrologic data, such as yields of existing wells, pressure potential of various formations, and water quality, should also be determined as accurately as possible.

Information on geologic conditions pertaining to groundwater supplies at prospective well locations is available upon request from the State Geological Survey. The Survey maintains a current file of subsurface information including drillers' logs and samples of drill cuttings, from which specific data on formation characteristics are available for many areas in Illinois. It also publishes basic geologic studies of a regional nature. Information on well yields, water levels, and water quality is furnished by the State Water Survey.

Domestic Groundwater Supplies

Development of groundwater supplies for domestic and stock use differs from municipal, industrial, and irrigation developments in three important aspects: 1) the quantity of water needed for domestic and stock purposes is considerably smaller and may, therefore, be provided from considerably thinner and less permeable aquifers; 2) the area within which a well can be constructed for domestic or stock purposes is normally small, usually a farmyard or a suburban lot; and 3) the cost of well construction must be low, which prohibits deep drilling.

In much of the area of this report geologic conditions are generally favorable for obtaining private water supplies at reasonable cost. Throughout most of the area, creviced dolomite and limestone are at sufficiently shallow depth to be within reach of private wells. Water-yielding sand and gravel are present in some areas. Sandstone, coal, and fractured shale in the Pennsylvanian system yield sufficient water for small wells in many localities.

Subsurface geologic conditions generally vary little within the limited area of an individual homesite or farm. However, there may be great changes in geologic conditions with depth. Information on depth of aquifers is valuable for planning the type, depth, and size of a well.

Perhaps the most important considerations in locating private wells are those of sanitation and convenience of location. Wells should be placed with regard to geologic conditions, surface drainage, topography, and land usage so as to provide maximum protection from harmful bacteria and objectionable inorganic material.

The following suggestions may be helpful in planning for individual or farm supplies.

1) Inventory the water requirements - estimate the amount of water needed for domestic use, stock use, milk cooling, washing, and fire protection.

2) Obtain all available information on the occurrence of water-yielding formations at the location. The maps in this report are designed to give a fundamental understanding of the occurrence and distribution of the water-yielding formations in this area so that the most suitable type of well can be planned. If additional more specific information is desired, address the State Geological Survey, Urbana, Illinois, giving: a) location of property by section, township, and range; b) intended use of the water supply; c) estimate of the quantity needed; and d) all information on existing wells on the property or previous drilling attempts.

3) Select a well driller with a reputation for constructing wells that have proved to be trouble-free. Make sure the driller is capable of properly handling the types of aquifers he may encounter at the location. If the well is to be finished in sand and gravel, select a driller experienced in setting well screens.

4) Check with the State Department of Public Health for regulations and suggestions on proper well construction and location and proper pump housing. The State Department of Public Health discourages the use of well pits on Grade A milk farms unless they are built to very rigid specifications. Properly constructed well pits are more expensive than other approved methods of pump installation.

5) Make periodic bacterial analyses of the water supply. Dug wells are more difficult to keep sanitary than are properly constructed drilled wells. Wells drilled into creviced dolomite and limestone formations are, however, also susceptible to bacterial pollution, particularly where the creviced formations are overlain by thin overburden.

Role of the Drilling Contractor

Much of the success of any drilled well depends on the skill and knowledge of the drilling contractor. A drilling contractor has certain duties and responsibilities to his customers.

1) The driller should provide an accurate log of the well or test hole at the time it is completed. The log should include a description of the formations, information on the static water level, basic construction features of the well (length and size of well casing and screen, etc.), and an indication of the capacity of the well as determined by a pumping test. Copies of the driller's log containing an accurate location should be filed with the State Geological Survey. Log books may be obtained by drillers, without charge, from the State Geological Survey.

2) The well should be constructed in accordance with accepted safe sanitary practices. The top of the well should be constructed to prevent surface pollution from entering the well or seeping downward around the casing. It is also desirable that well construction allow for measurement of the depth to water without requiring removal of the pumping equipment.

3) The driller should endeavor to take full advantage of any water-yielding formations he may encounter. In areas where groundwater conditions are generally unfavorable, it takes a skillful driller to obtain the maximum amount of water from a poor formation. Where sand and gravel aquifers are used as a source of groundwater, the driller should select a well screen on the basis of size and sorting of the formation material. After construction the well should be properly developed. A properly screened and developed well in sand and gravel will not pump an objectionable amount of sand or silt during service.

4) It is desirable to save samples at 5-foot intervals for the total depth of drilling, especially for municipal, industrial, irrigation, and school wells. The State Geological Survey files samples of drill cuttings received from drillers. The samples may be sent express collect to the Survey where they will be studied and kept on file for reference. Information obtained from samples is vital in effective rehabilitation of old wells.

COUNTY GROUNDWATER SUMMARIES

Detailed information on groundwater supplies in the counties of western Illinois, south part, follows. These discussions supplement the geologic information shown on the maps in figures 6 and 7 and given in table 1.

Adams County

In Adams County thick permeable sand and gravel deposits suitable for high-capacity wells are present at many locations in the valley of the Mississippi River where the fill is as much as 125 feet thick. Drillers report mainly coarse material below 45 feet. Deposits of sand and gravel are locally present along tributaries of the Mississippi such as Mill Creek, Ursa Creek, and Bear Creek. Deposits are not always confined to the valley along these tributaries, but in some cases also occur below the bordering upland. East of Quincy, portions of the Mill Creek bedrock valley underlie the upland and contain water-yielding deposits that are more than 150 feet below the surface.

Thin sand and gravel deposits containing considerable amounts of chert occur in the lower part of the drift on the upland in the west half of the county. These are suitable water sources for drilled or dug farm wells at some locations.

The Keokuk-Burlington limestone, present beneath the entire upland in the county, is the main source of private water supplies. Water is generally obtained from wells penetrating the limestone for 120 to 140 feet, and ranging in depth from 200 to 350 feet. At some places the upper, weathered part of the formation, composed of well-creviced rock and pockets of loose chert, is a source of water. The limestone is suitable mainly for small private groundwater supplies and commonly yields water more or less charged with hydrogen sulfide. Payson and Loraine obtain water from the Keokuk-Burlington limestone with wells ranging from 300 to 330 feet in depth.

Groundwater possibilities in deeper bedrock formations are fair to poor. The Devonian-Silurian limestone, which is absent near the southwestern corner and is less than 50 feet thick in much of the county, is not highly creviced and at some locations contains shows of gas, associated with saline water. Similarly, the Kimmswick-Joachim dolomite is "tight" or yields water of poor quality.

The St. Peter sandstone, encountered at depths ranging from 650 to more than 900 feet, yields water that is too salty for most purposes, according to analyses by the Illinois Geological Survey (Meents, et al., Ill. Pet. 66, 1952, p. 36). Analyses of water from the St. Peter sandstone from two wells in sec. 11, T. 2 S., R. 6 W., and sec. 26, T. 2 S., R. 8 W., show 8210 ppm total solids with 3876 ppm chlorides and 12,258 ppm total solids with 6398 ppm chlorides respectively.

Brown County

In Brown County the Illinois Valley, containing river deposits up to 75 feet thick, is the most favorable area for developing municipal and industrial groundwater supplies, though consideration must be given to water quality. Wells less than 50 feet deep penetrating more than 20 feet of sand and gravel have been constructed in the valley near the bluffs by the Village of Versailles, located on the upland about two miles west of the valley.

Thinner, less continuous sand and gravel deposits in the La Moine River valley have been developed as supplementary water sources at Mt. Sterling. In the remainder of the county, where the glacial drift is generally less than 50 feet thick, consists mainly of tight till, and is extensively dissected by tributaries of the Illinois River, water-bearing sand and gravel deposits are rarely encountered.

The Keokuk-Burlington limestone is the primary source of groundwater for domestic supplies. In most of the county it is within 250 feet of land surface but is overlain by Pennsylvanian rocks, Kinderhook shale, or both (fig. 6). Drilling into the limestone about 130 feet is usually necessary to penetrate the most favorable water-yielding zones, although at a few locations where the limestone is highly fractured in its upper few feet good wells result with only shallow penetration. Oil and gas shows and associated highly-mineralized water have been reported in the Devonian-Silurian rocks in the area.

The permeable St. Peter and deeper Cambrian sandstones which occur interbedded with thick dolomite formations below a depth of 1000 feet (fig. 4) are potential water sources, though high mineralization (4076.4 ppm residue with 1310 ppm chlorides) is reported by the State Water Survey for a water sample from an old well at Mt. Sterling drilled more than 2000 feet deep and penetrating the sandstones (Illinois Water Survey Bull. 21, 1925, p. 455).

Calhoun County

In Calhoun County groundwater conditions are highly variable because of the intense dissection of the upland and the strong deformation of the bedrock along the Cap au Gres faulted flexure (fig. 5).

Water supplies from sand and gravel are generally available in the Mississippi and Illinois River valleys. Deposits in the latter are 150 feet thick near the east river bank opposite Hardin, and consist mainly of sand below a depth of about 30 feet. Shallow deposits are reported to yield water of better mineral quality, with less iron, than the deeper deposits. Small supplies of water may be obtained from thin beds of sand and gravel at depths less than 50 feet in river terrace deposits of tributary valleys south of the Cap au Gres faulted flexure. Glacial deposits are absent on the uplands, except for a small area in the vicinity of Batchtown. Here water has been obtained from glacial gravels at depths ranging from 35 to 65 feet.

Wells on the uplands obtain water from the Keokuk-Burlington limestone in the northern quarter of the county, in the Devonian-Silurian dolomite from near Kampsville to five or six miles south of Hardin, in the Kimmswick-Joachim dolomite from east of Batchtown south to the Cap au Gres flexure, and in the St. Louis limestone south of the flexure. The limestones and dolomites are not extensively creviced and consequently yield water supplies suitable only for small domestic wells.

Springs are abundant in the limestone uplands, and have been extensively used as sources of private, school, and community water supply.

The St. Peter sandstone is more permeable than the shallower limestone and dolomite formations, and in some areas is an excellent source of groundwater, particularly near its area of outcrop along the Mississippi River north of the Cap au Gres flexure.

The State Water Survey records the following water analysis in parts per million from a 453-foot well open to the Kimmswick-Joachim dolomite and St. Peter sandstone at Batchtown: residue, 402; hardness, 310; alkalinity, 392; chlorides, 7; and sulphates, 17.8. The quality of water in the St. Peter declines sharply to the north and east as the formation gets deeper. South of the Cap au Gres flexure the St. Peter is more than 1000 feet deep and yields salt water.

Detailed information on the geology of Calhoun County is available in United States Geological Survey Professional Paper 218 (Rubey, 1952).

Cass County

Sand and gravel deposits suitable for small to large groundwater supplies are present in the drift and river valley fill in more than half of Cass County. Drilling in the Illinois River valley in the vicinity of Beardstown shows deposits at least 100 feet thick, consisting mainly of sand and gravel. Wells show a gradation downward from sand through fine gravel to medium or, locally, coarse gravel. Although the deposits thin and become finer near the bluffs, the entire flood-plain area is considered favorable for exploration for sites for high-capacity wells. Similar deposits and groundwater conditions exist along the wide Sangamon River flood plain in the northern part of the county.

In the upland area, drift more than 150 feet thick occurs in a bedrock valley 3 to 4 miles wide that passes eastward from the Illinois Valley between Virginia and the southern edge of the county (fig. 7). Records of wells in the valley show the fill to be composed almost entirely of glacial till or of glacial till interbedded with deposits of sand and gravel that have accumulative thickness of as much as 50 feet.

In the northern part of Cass County the drift has been intensively dissected by tributaries of Sangamon River and most drilled wells go into the Pennsylvanian or Keokuk-Burlington bedrock. South and east of Chandlerville many wells obtain water from just below the No. 2 coal at depths less than 100 feet. The Pennsylvanian rocks thicken eastward, and extend to a depth of about 400 feet along the east county line.

Mississippian limestones underlie the drift in the western part of the county but are seldom penetrated for water supplies because of the availability of water in the shallower sand and gravel deposits.

The Devonian-Silurian formations, Kimmswick-Joachim dolomite, and St. Peter sandstone have been penetrated in several wells at Beardstown and in oil tests on the uplands. These horizons are considered unfavorable groundwater sources because they are likely to yield highly mineralized water.

Greene County

Deposits in the Illinois River valley in Greene County range up to 150 feet thick and include highly permeable sand and gravel. Macoupin and Apple Creek valleys, as well as other smaller tributaries, also contain thin, discontinuous deposits of sand and gravel that locally provide adequate groundwater for farm and small municipal supplies, such as at Greenfield.

The glacial drift on the uplands averages about 50 feet in thickness and has scattered pockets of sand and gravel that yield water. A number of these are reported east of Carrollton to the vicinity of Greenfield and Fayette.

The principal source of private and municipal supplies of groundwater in the county is the creviced Keokuk-Burlington limestone. Municipal supplies at Carrollton have been obtained for many years from springs that issue from fissures in the limestone cropping out along a small tributary of Apple Creek. Roodhouse obtained water from similar springs along a tributary of Sandy Creek, but later drilled 150-foot wells into the Keokuk-Burlington limestone near the springs and secured yields of more than 400 gpm (Illinois Water Survey Bull. 40).

Water is also obtained from Pennsylvanian rocks and the Salem limestone (fig. 4) in the eastern half of the county. East of Roodhouse many domestic wells are finished in fractured shales or sandstones above or a few feet below coal beds at a depth less than 100 feet. In wells where suitable water supplies are not obtained in the Pennsylvanian rocks in this area drilling is extended into the underlying Salem or Keokuk-Burlington limestones.

Drilling for private water supplies rarely goes below the Keokuk-Burlington limestone, although the 200-foot thick Devonian-Silurian limestone and dolomite is a potential source of small to moderate amounts of groundwater along the western edge of the county. Deeper horizons, including the St. Peter sandstone, are considered unfavorable groundwater sources because of poor quality of the water.

Hancock County

In Hancock County permeable sand and gravel deposits occur along the Mississippi River south of Warsaw where the valley flat attains a width of 4 miles, but are thin and restricted north of Warsaw where the river flows through a narrow channel cut in Mississippian limestone. Less extensive, locally thick, permeable sand and gravel deposits also occur associated with the valleys of Bear Creek, LaMoine River, and LaHarpe Creek and with a buried bedrock valley which is partially outlined by dashes in figure 7.

Glacial deposits within the buried valley are not well known. In eastern Hancock and southwestern McDonough counties sand and gravel deposits more than 50 feet thick underlie the surficial glacial till. Favorable water-yielding deposits are also present locally in the lower part of the valley, more or less coincident with Bear Creek. North of Carthage, in the central part of the county, the fill appears to be largely tight glacial till.

The Keokuk-Burlington limestone is within 200 feet of the surface in most of the county and is the main source of groundwater supplies in the bedrock. At some locations water is obtained from a weathered creviced zone at the top of the limestone, but more commonly penetration of more than 100 feet is necessary to obtain adequate water for domestic or farm supplies. Water-yielding zones are rarely encountered in the Salem and Warsaw formations which overlie the Keokuk-Burlington. Pennsylvanian rocks are generally absent, although along the east edge of the county and in isolated outliers to the west thin Pennsylvanian rocks occur beneath the drift and include sandstones that yield groundwater. At Bowen a 42-foot Pennsylvanian sandstone is encountered at a depth of 48 feet.

The Devonian-Silurian rocks and the Kimmswick-Joachim dolomite are reported to be poorly to only moderately creviced, and therefore are not considered favorable horizons in which to attempt to obtain groundwater supplies, in view of the depth of drilling necessary to test these formations. Depth to the Devonian-Silurian rocks ranges from 450 to as much as 750 feet. The Kimmswick-Joachim is 100 to 200 feet deeper.

Water from the Kimmswick-Joachim dolomite, St. Peter sandstone, and deeper Cambrian formations was formerly obtained at Carthage from wells ranging in depth from 847 to 1700 feet (Illinois Water Survey Bull. 21, 1925,

p. 114). This source was abandoned in favor of a surface supply, and at present, drilling into the deeper formations is undertaken only in the course of oil exploration.

Jersey County

In Jersey County water-yielding sand and gravel deposits suitable for drilled wells are found mainly in the Illinois River valley and locally in Otter and Macoupin Creek valleys. Extensive test-drilling in Otter Creek valley by the City of Jerseyville showed permeable deposits less than 50 feet below the valley flat in T. 7 N., R. 12 W., west of the city's limestone springs, and finer grained, less permeable material in the lower part of the valley adjacent to Illinois River. Sand is commonly encountered below 30 feet in the Illinois River valley, and coarse sand usually below 50 feet.

Many farm wells in the eastern half of Jersey County obtain small supplies of water from fractures in Pennsylvanian shales within a depth of 180 feet (fig. 6). In wells drilled into underlying Mississippian limestones the Pennsylvanian rocks are commonly cased off to prevent caving of the shales.

The Keokuk-Burlington limestone is the source of private groundwater supplies in much of the county, with wells ranging in depth from less than 50 feet in some of the hollows east of the confluence of the Illinois and Mississippi rivers to more than 350 feet on the upland east of Jerseyville. At shallower depths in the eastern two-thirds of the county the St. Louis-Salem limestone (fig. 4) is sufficiently thick and creviced at some places to yield water for farm wells.

Devonian-Silurian rocks are extensively exposed along the Illinois River bluffs above the confluence with the Mississippi in the southwestern part of Jersey County, and locally yield water. The Kimmswick-Joachim rocks which occur about 150 feet below the base of the Silurian rocks in the same area commonly contain water unsuitable for domestic use.

In Jerseyville's old 1542-foot well into the St. Peter sandstone, salt water was reported in the Kimmswick-Joachim at a depth of 1040 feet, and after casing was set to a depth of 1367 feet, a water analysis by the Illinois Water Survey showed a mineral content of 3012 ppm with 1347 ppm chlorides (Bull. 40, 1950). Analysis by the Illinois Geological Survey of a water sample from the St. Peter at a depth of 1700 feet seven miles east of Jerseyville showed 9040 ppm total solids and 5234 ppm chlorides (Illinois Geol. Survey Ill. Pet. 66, 1952, p. 37).

Morgan County

Sand and gravel deposits, which outside of the Illinois River valley are generally thin and discontinuous, are more common in the northern half of Morgan County where the glacial drift is from 50 to 150 feet thick. In the bedrock valley area outlined by dashes in figure 7, sand and gravel up to 35 feet in thickness is reported, but little information is available on the nature or productivity of the deposits. Mauvaise Terre Creek locally contains sand and gravel which formerly was utilized by Jacksonville as a source of water supply.

Pennsylvanian rocks, which underlie the drift in the uplands, range in thickness from 25 to 50 feet near the river bluffs to more than 400 feet in the southeastern part of the county. At some locations private wells are finished in sandstone or fractured coal, shale, or limestone in the Pennsylvanian rocks within 200 or 300 feet of land surface.

The Salem limestone underlies the Pennsylvanian rocks and in many places is penetrated for domestic groundwater supplies. Water-bearing crevices in the Salem are not abundant, with the result that yields are generally low. Depth to the Salem ranges from 175 to about 550 feet from northwest to southeast.

The Keokuk-Burlington limestone is usually more than 200 feet below the top of the Salem and is rarely reached in domestic wells. Depths of the Devonian-Silurian and St. Peter rocks in the eastern part of the county are shown in table 1.

Drilling for water in the bedrock is somewhat restricted by the presence of gas in the lower Pennsylvanian and Salem rocks in T. 15 N., R. 9 W. and in Devonian rocks in T. 13 N., R. 8 W. The water associated with the gas in these areas is usually not potable. Analysis of water from the Devonian-Silurian rocks at a depth of 1020-1039 feet in sec. 22, T. 13 N., R. 8 W. shows 30,584 ppm total solids with 16,635 ppm chlorides (Illinois Geol. Survey Ill. Pet. 66, 1952, p. 35).

Jacksonville formerly supplemented a surface supply with 3100-foot wells that penetrated the St. Peter sandstone between depths of 1540 and 1837 feet and passed into Cambrian sandstones at a depth of 2080 feet (Illinois Water Survey Bull. 21, 1925, p. 297). According to Water Survey analysis this water had a mineral content of 2431 ppm with 1000 ppm chlorides. Mineralization of water from these formations increases eastward as the formations get deeper.

Pike County

Extensive water-yielding sand and gravel deposits occur only in the Mississippi River valley and, in the northeastern part of Pike County, in the Illinois River valley. Municipal water supplies are obtained from sand and gravel in the Mississippi Valley from wells commonly less than 75 feet deep at Pleasant Hill, New Canton, Barry, Kinderhook, and Hull. The valley fill near the river, composed mainly of sand and gravel below a depth of 20 to 40 feet, attains a thickness of more than 130 feet. In the Illinois River valley in the northeastern part of the county, the fill thickens from less than 20 feet near the bluff to about 80 feet near the river.

Tributary valleys such as Bay Creek and McKee Creek locally contain water-yielding sand and gravel suitable for small municipal supplies, such as at Nebo, Griggsville, and Perry. Favorable deposits on the uplands are thin and discontinuous.

The Keokuk-Burlington limestone (figs. 4 and 6) is the primary source of groundwater for private supplies in Pike County. Drillers report that water is obtained in the upper 60 feet of the formation where crevicing is most extensive. At some locations, particularly east of Pittsfield, the upper 25 to 30 feet of the formation is composed of broken, rubbly rock which yields water readily. The formation is less favorable for obtaining water west of the anticlinal belt running northwestward through Pittsfield, including the area of the old Pittsfield gas field.

The Devonian and Silurian rocks (fig. 4) have been extensively tested for oil and gas and are not considered favorable groundwater sources. Along the Pittsfield anticline they locally contain gas and yield salt water. An analysis of water from the interval in sec. 12, T. 3 S., R. 2 W., in northeastern Pike County, shows 9764 ppm total solids with 5262 ppm chlorides (Illinois Geol. Survey Ill. Pet. 66, 1952, p. 35).

The St. Peter sandstone, which is encountered at depths from 600 to 1000 feet below land surface, is permeable and water-yielding, but at most locations, especially from Pittsfield eastward, the water is probably highly mineralized. Somewhat more favorable water quality is to be expected west of Pittsfield where the St. Peter formation is shallower. Casing off the Kimmswick-Joachim formations and penetrating the sandstone only for 25 to 50 feet is recommended for water wells attempted in the St. Peter formation. Formations below the St. Peter yield water too highly mineralized for most purposes, according to analyses of waters from wells over 2000 feet deep at Barry and Pittsfield (Illinois Water Survey Bull. 21, 1925, p. 54, 521).

Schuyler County

In Schuyler County the Keokuk-Burlington limestone, which is encountered at depths ranging from 50 feet along LaMoine River to more than 350 feet on the uplands just east of Rushville, is the main source of domestic groundwater supplies. It is commonly 200 feet thick, although drilling usually penetrates only the upper two-thirds of the limestone, the part reported to be the best creviced. At some locations water is obtained from limestone and chert rubble at the top of the formation.

On the uplands the Keokuk-Burlington is overlain by Warsaw shale, thin Salem limestone, Pennsylvanian rocks, and glacial drift (figs. 4 and 6). At a few locations drilled wells obtain water from the Salem limestone or Pennsylvanian fractured shales, limestone, or coals, but these rocks are generally less likely sources of groundwater than the Keokuk-Burlington. The Devonian-Silurian rocks at some locations in the county contain minor amounts of oil and gas, commonly associated with saline water. Water in the deeper bedrock formations (St. Peter sandstone and below) is of uncertain quality and in some places not potable. Analysis of water from a well drilled into the St. Peter formation at Rushville shows 4284.8 ppm residue with 1485 ppm chlorides (Illinois Water Survey Bull. 21, 1925, p. 577).

Sand and gravel, which occurs extensively only in the Illinois River valley, is the best source of large groundwater supplies for industrial and municipal use in the county. Deposits in the valley are less than 75 feet thick, but they contain coarse permeable material within 10 to 25 feet of the surface. One of the Rushville municipal wells, located on the valley flat near the bluffs 6 1/2 miles southeast of the city, is 50 feet deep and has been tested at 300 gallons per minute with 1 1/4 feet of drawdown (Illinois Water Survey Bull. 40, 1950).

Thinner, discontinuous sand and gravel deposits, which occur in the valley of LaMoine River, are potential sources of moderate industrial and municipal groundwater supplies. The upland is underlain by well-dissected, thin impermeable glacial drift in which sand and gravel deposits capable of supplying even domestic wells are rarely encountered.

Scott County

In Scott County excellent water-yielding sand and gravel deposits occur in the Illinois River valley at depths less than 125 feet. Test-drilling by the City of Jacksonville adjacent to the river a mile south of the north county-line showed nearly continuous sand and gravel below a depth of about 25 feet. The following section was penetrated in one of the test wells:

Description	Thickness (ft.)	Depth (ft.)
Silt, fine, sandy	25	25
Sand, medium, traces of gravel	9	34
Sand, medium, with 15% pea gravel, 5% medium gravel	16	50
Sand, medium, with 10% pea gravel, clay balls	2	52
Sand, medium, traces of gravel	8	60
Sand, gray, with 10% medium gravel	9	69
Sand, medium, with 15% medium coarse gravel	20	89
Sand, medium, with 40% medium coarse gravel	6	95
Sand and gravel, cemented	2	97 T.D. *

Thinner, less continuous sand and gravel deposits occur in the valley of Sandy Creek. Winchester obtains groundwater from deposits 20 to 30 feet thick encountered at a depth of 20 feet in the valley a mile south of town. Water-yielding sand and gravel deposits on the upland are rare, although a few successful private wells have been completed in sand and gravel west of Winchester.

Most drilled wells in Scott County are completed in Mississippi limestone bedrock at depths less than 300 feet (fig. 4). The Keokuk-Burlington limestone occurs at shallow depths in the west part of Scott County and east of Winchester (fig. 6). In the northeast and southeast townships where thin Pennsylvanian rocks overlie Mississippian rocks it is customary to finish wells in the Keokuk-Burlington and case off the overlying shales and drift. At some locations in these townships water is obtained from coal beds, sandstones, or fractured limestones or shales in the Pennsylvanian rocks.

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* Limestone bedrock at 97 feet.

Table 1. - Key Wells Showing Sequence and Depths of Formations at Selected Locations

Dash (-) indicates formation absent. TD = total depth of well. See fig. 4 for information on rock types, water-yielding characteristics, and drilling and well-construction procedures.

Well no.	Location (See fig. 2)	Surface elev. (Ft. above sea level)	Drift	Pennsylvanian	St. Louis-Warsaw	Keokuk-Burlington	Kinderhook	Devonian - Silurian	Maquoketa	Kimmswick - Joachim	St. Peter	Finished in and TD
			DEPTH OF FORMATIONS (IN FT.)									
1	Hancock 26-7N 8W	690	0 to 45	-	45 to 115	115 to 260	260 to 583	583 to 730	-	730 to 977	977 to 1100 TD	
2	Hancock 22-3N 6W (Bowen)	680	0 to 48	48 to 97	97 to 213	213 to 395	395 to 405 TD					
3	Adams 2-1N 9W	493	0 to 127	-	-	-	127 to 370	370 to 484	484 to 496	496 to 703	703 to 707 TD	
4	Adams 24-1N 5W	740	0 to 50	50 to 200	200 to 300	300 to 495	495 to 685	685 to 693	693 to 735 TD			
5	Schuyler 30-2N 1W (Rushville)	638	0 to 7	7 to 212	212 to 280	280 to 504	504 to 715	715 to 760	760 to 950	950 to 1245	1245 to 1510 TD	
6	Adams 31-1S 7W	725	0 to 100	-	-	100 to 245	245 to 445	445 to 500	500 to 600	600 to 835 TD		

7	Cass 2-17N 10W	627	0 to 175	175 to 312	312 to 490	490 to 710	710 to 935	935 to 1060	1060 to 1070 TD			
8	Pike 12-3S 2W	430	0 to 80	-	-	80 to 240	240 to 425	425 to 505	505 to 700	700 to 715 TD		
9	Pike 15-4S 5W	716	0 to 40	-	-	40 to 185	185 to 355	355 to 408	408 to 578	578 to 872	872 to 1090	Granitic type rock 3207
10	Morgan 25-15N 9W	650	0 to 138	138 to 382	382 to 512	512 to 834	834 to 1041	1041 to 1238	1238 to 1430	1430 to 1590 TD		
11	Pike 21-5S 4W	810	0 to 46	-	-	-	46 to 158	158 to 198	198 to 361	361 to 645	645 to 870	Granitic type rock 2226
12	Morgan 28-13N 8W	634	0 to 46	46 to 385	385 to 727	727 to 904	904 to 1175	1175 to 1406	1406 to 1585	1585 to 1754 TD		
13	Greene 26-12N 13W	636	0 to 42	-	-	42 to 230	230 to 400	400 to 545	545 to 720	720 to 1063	1063 to 1100 TD	
14	Calhoun 10-9S 2W	430	0 to 42	-	-	42 to 49	49 to 84	84 to 198	198 to 365	365 to 705	705 to 850	Cotter(?) dolomite 996
15	Greene 22-10N 12W	606	0 to 59	59 to 70	-	70 to 300	300 to 500	500 to 728	728 to 900	900 to 1235	1235 to 1327 TD	
16	Jersey 28-8N 11W (Jerseyville)	646	0 to 26	26 to 100	100 to 207	207 to 480	480 to 530	530 to 810	810 to 975	975 to 1362	1362 to 1542 TD	

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Significance of Pleistocene deposits in the groundwater resources of Illinois: J. W. Foster, Econ. Geol., v. 48, no. 7, November 1953.

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Other general reports on groundwater geology in Illinois similar in purpose and scope to the present study include the following circulars: C. 192, Water wells for farm supply in central and eastern Illinois; C. 198, Groundwater possibilities in northeastern Illinois; C. 207, Groundwater in northwestern Illinois; C. 212, Groundwater geology in southern Illinois; C. 222, Groundwater geology in western Illinois, north part; and C. 225, Groundwater geology in south-central Illinois. These circulars, published by the Illinois State Geological Survey, are available free on request.

Topographic maps are available for the area covered in this report. These maps are on a scale of approximately 1 inch to the mile. They are printed by quadrangles and may be obtained from the Illinois State Geological Survey, Urbana, Illinois, or from the United States Geological Survey, Washington 25, D. C., for 30 cents each. Index maps showing the topographic map coverage of the State are free on request.

Detailed geologic reports have been published or are in preparation for the following quadrangles: Colchester, Macomb, Tallula, Springfield, Hardin, Brussels, and Beardstown. Information on these reports may be obtained from the Illinois State Geological Survey in Urbana.

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